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Flexible Solid-State Supercapacitors Based on Tussock-Like Metal Oxide Nanowire Arrays

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Abstract:

Flexible solid-state supercapacitors (FSSSCs) are of considerable interest as mobile power supply for future portable electronics [1,2]. Ternary transition metal oxides such as NiCo_2O_4 and MnCo_2O_4 have received increasing attention as high-performance supercapacitor electrode materials due to their enhanced conductivity and electrochemical activity compared to binary transition metal oxides [3,4]. However, few attempts have been reported to date regarding the development of CuCo_2O_4 based FSSSCs. In this study, a microwave assisted hydrothermal method combined with a simple thermal annealing process is employed to in-situ synthesize CuCo_2O_4 nanowire arrays on commercial graphite papers. Phosphoric acid preactivation on graphite papers can effectively enrich their surface active sites for growth of CuCo_2O_4 nanowires. Through the synergistic structure-adjustment effects of polyvinyl pyrrolidone and Cu^{2+} , a tussock-like highly-porous microstructure assembled from CuCo_2O_4 nanowires is uniformly constructed onto the surface of graphite papers (Figure 1). The resulting electrode material was very conducive to realizing multidimensional electron transport and rapid electrolyte ions diffusion. Thanks to these merits, the as-prepared flexible paper electrode can deliver a high specific capacitance of 1787 F g^{-1} at 1 A g^{-1} in 1 M KOH in a two-electrode system, as well as superior cycling stability and good rate performance. An asymmetric supercapacitor composed of the as-prepared CuCo_2O_4 based positive electrode, an activated carbon based negative electrode and a polyvinyl alcohol based gel electrolyte is being fabricated and tested. The initial results have laid a solid foundation for developing practical high-performance FSSSCs and further applying them for powering diverse portable electronics.

Keywords: flexible solid-state supercapacitors, portable electronics, transition metal oxides, nanowire arrays, graphite papers, paper electrodes, gel electrolyte.

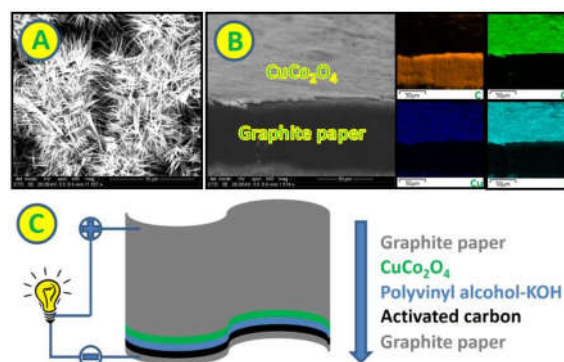


Figure 1: (A) A scanning electron microscope image of tussock-like CuCo_2O_4 nanowire arrays (top view); (B) a scanning electron microscope image of CuCo_2O_4 nanowire arrays loaded on graphite papers (tilted side view) with C, Co, Cu and O mapping results; (C) a schematic of the proposed FSSSC.

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21 Jun, 2018

SMS 2018
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